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CHEMICAL & ENGINEERING

NEWS

1988 Employment Outlook

Fast-changing technology is spurring reconsideration of chemical education
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CHEMICAL & ENGINEERING NEWS

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OCTOBER 26, 1987

News of the Week

■ **Chemical companies' stocks took a plunge during last Monday's stock market crash, reflecting the general panic rather than the chemical industry's prospects.** **Page 6**

■ **The Chemical Manufacturers Association issues recommendations on chemical arms treaty, outlining areas such as proprietary information and on-site inspections that it believes need more debate.** **Page 7**

■ **UNESCO's executive board voted to nominate Spanish biochemist Federico Mayor Zaragoza as the organization's next director general after controversial incumbent withdraws.** **Page 7**

■ **NIH celebrates its centennial with five days of scientific symposia, an NIH alumni reunion, and several commemoration ceremonies.** **Page 8**

Business

Mexican chemical industry, boosted by petrochemical reclassification, has increased private investments, production, and exports, as it aims to become internationally competitive. **Page 11**

Government

Clean Sites Inc., founded three years ago to speed cleanup of abandoned hazardous waste sites, overcomes early obstacles. **Page 14**

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Education

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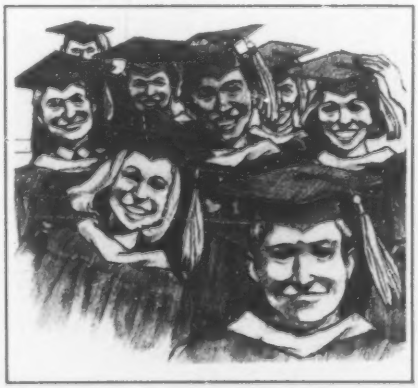

Employment Outlook

C&EN's annual look at the job market highlights proposed restructuring of chemical education to better prepare students for work in new high-technology areas. **Page 33**

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LETTERS

Aspartame and seizures

SIR: As president of the Epilepsy Institute of New York, I empathize with John S. Connolly in his search for the underlying cause of seizure disorder in his 20-year-old daughter (C&EN, Sept. 7, page 4). However, C&EN readers should know that, contrary to Connolly's anecdotal report, the weight of scientific evidence to date simply does not support a link between aspartame and seizures.

The Epilepsy Institute, a not-for-profit organization devoted to people suffering from seizure-related problems, has reviewed the scientific research on aspartame and concluded that the ingredient is safe for people with epilepsy. After reviewing records of some 5000 client visits to the institute, the professional advisory board concluded that there has been no change among seizure pattern of individuals, many of whom use aspartame.

The Epilepsy Foundation of America informs persons that "medical authorities who have reviewed the literature have found that, at this time, there is no scientific documentation to establish a cause and effect relationship between aspartame and seizures." The American Medical Association, American Academy of Pediatrics, American Diabetes Association, and regulatory authorities in more than 60 countries worldwide also have concluded that aspartame is safe.

Anecdotal reports of seizures in humans have been investigated by the Food & Drug Administration and the Centers for Disease Control. In a 1984 report, CDC concluded that there was no consistent or unique pattern of symptoms that would indicate a causal link between the symptoms and aspartame consumption. In its review of 175 seizure reports since the CDC analysis, FDA concluded in 1986 that there is "no consistent association between occurrence of seizures and exposure to aspartame-containing products."

Approximately 1% of the American population suffers from seizures. Epilepsy is second only to stroke as the leading neurological disorder affecting the U.S. population. Seizure susceptibility can be related to high fever, allergic reactions, drug and alcohol withdrawal, hormone variations, and a variety of other factors.

Under these circumstances, and because aspartame is frequently consumed by large numbers of people, it is not surprising that FDA concluded in 1986 that "there may be a chance occurrence of seizure activity following ingestion of aspartame by seizure-prone people. Such a happenstance, however, is not indicative of a causal relationship between consumption of aspartame and the onset of seizure activity."

As a scientist, Connolly should know that reports of alleged adverse effects from aspartame have not been reported as widely in scientific journals as in the popular press because such anecdotal reports are not based on conclusive evidence of cause and effect. There is no way to determine whether individuals would have linked seizures or other maladies to aspartame prior to hearing publicity about such alleged effects.

Studies are under way at Mt. Sinai Medical Center and Yale University to evaluate the specific neurological condition of individuals who have reported seizures, and for whom physicians have not been able to diagnose other causes.

In summary, we at Epilepsy Institute certainly want to evaluate carefully any allegation relating to the health of our patients. After examining the weight of scientific evidence in this area, we continue to affirm that aspartame is safe for persons with epilepsy.

Ira Brody
President
Epilepsy Institute, N.Y. City

Combustion chemistry

SIR: We were delighted to see the recent special report, "Combustion Chemistry" (C&EN, Aug. 31, page 22) relate the significance of the Brookhaven flash photolysis-shock tube (FP-ST) experiment. Jim Miller and George Fisk accurately reported that the FP-ST method circumvents the problem of isolating elementary reactions that is common with conventional shock tube methods. Indeed, the Brookhaven FP-ST apparatus has produced rate constants for several elementary reactions [Michael, J. V., Sutherland, J. W., Klemm, R. B., *J. Phys. Chem.*, **90**, 497 (1986); Sutherland, J. W., Michael, J. V., Klemm, R. B., *J. Phys. Chem.*, **90**, 5941 (1986); Sutherland, J. W., Michael, J. V., Pirraglia, A. N., Nesbitt, F. L., Klemm, R. B., "21st International Symposium on Combustion," Combustion Institute, in press] at the highest temperatures attained to date via a direct method.

Unfortunately, the authors were less than thorough in giving credit for the development of the FP-ST method. First, the work of Reinhard Zellner and coworkers [Ernst, J., Wagner, H. Gg., Zellner, R., *Ber. Bunsenges. Phys. Chem.*,

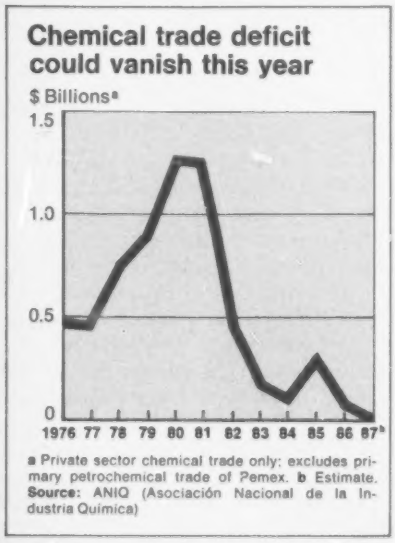
Mexican Chemical Outlook Continues To Improve

Petrochemical reclassification boosts private investment, output and exports rise, and imports shrink—all spurring international competitiveness

Earl V. Anderson, C&EN New York

As Leopoldo Rodriguez Sanchez puts it, the Mexican chemical industry came through last year's "test of fire" economic recession with flying colors. Rodriguez, who is president of ANIQ, Mexico's chemical industry trade association, noted at a recent meeting of the organization that, although Mexico's gross national product dropped 3.8% last year, chemical industry output grew 1.2%—five full percentage points better than the overall Mexican economy.

Just as important, that momentum seems to be carrying over into this year. And the enthusiasm that awoke within the industry last year after a four-year hibernation is still very much alive.

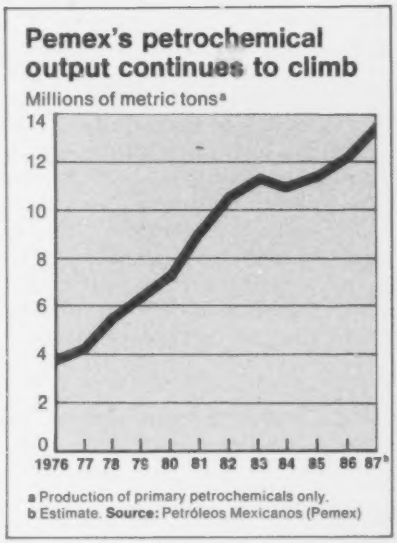

Chemical trade deficit could vanish this year
$ Billions[a]
1.5
1.0
0.5
0
1976 77 78 79 80 81 82 83 84 85 86 87[b]
a Private sector chemical trade only: excludes primary petrochemical trade of Pemex. b Estimate. Source: ANIQ (Asociación Nacional de la Industria Química)

Chemical production is increasing in Mexico, both in the private sector and in Petróleos Mexicanos (Pemex), the government oil company that, by law, produces all primary petrochemicals. Exports are increasing. Imports are shrinking. And the perennial trade deficit that has burdened Mexico's chemical industry may even disappear this year, at least in the private sector. The government wants its chemical industry—a priority industry in Mexico—to become internationally competitive. The industry is taking the challenge seriously.

Excluding Pemex's exports and imports of primary petrochemicals, the trade deficit of Mexico's private chemical sector shrunk to $95.6 million last year. That may sound unimpressive, but it is a hefty 72% less than 1985's deficit of $342 million. Rodriguez thinks that the private chemical sector deficit can be completely eliminated this year. Nobody is openly calling him wrong.

Several developments have triggered this optimism within the Mexican chemical industry. An important one is Pemex's intention to push ahead with its ambitious petrochemical plant-building program. But perhaps even more important was last year's government decision to reclassify 36 primary petrochemicals as secondary petrochemicals (C&EN, Nov. 17, 1986, page 14).

Rodriguez calls that petrochemical reclassification "the primary structural change" that has occurred within Mexico's chemical industry. What it means is that 36 petrochemicals, including such important products as polypropylene, are no longer the sole domain of Pemex. They can be produced by private companies, including foreign investors.



The private sector, including several foreign companies, evidently is leaping at the opportunity. According to Alberto Escofet Artigas, undersecretary of mines and basic industry within the Department of Energy, Mines & State Industry, the Mexican Petrochemical Commission has received more than 100 applications for petrochemical investment and building permits during the first nine months of this year. The commission, which must approve all petrochemical projects in the private sector, has already granted 82 new permits so far this year. That's more permits than were granted in the three-year stretch from 1984 through 1986, says Escofet.

Escofet estimates that the 82 plants given the green light so far represent an investment of about $670 million. They will increase secondary petrochemical production by more than 2 million metric tons—23% of present capacity—and will generate 4500 permanent jobs. They also probably will boost Mexico's private sector chemical exports by

$500 million per year. What Escofet, or anyone else, is not saying is what products these permits cover. That information hasn't been made public yet. But polypropylene, propylene oxide, acetic acid, acetic anhydride, acetaldehyde, and 2-ethylhexanol are likely candidates.

All of this activity in the Mexican chemical industry is geared to transforming it into a serious international competitor. The goal is to supply, not only the growing domestic market, but the international market as well.

This philosophy is as apparent in Pemex as it is in the private sector. Francisco Rojas, director general of Pemex, says that this is a much better approach than the "old fashioned" plan of just import substitution. As part of what Rojas calls Pemex's "petrochemical transformation," the company will try to minimize the use of crude and maximize the use of natural gas. It will accelerate construction of petrochemical plants, giving priority to those that will be most productive. It also will give priority to those investments that will guarantee the highest foreign exchange.

It's no surprise that foreign exchange is a high-priority item for Pemex petrochemical management. The company's petrochemical balance of trade deficit dropped 46% last year, compared with 1985. But it still remained at a sizable $295 million. The good news is that Pemex's imports of primary petrochemicals dropped 43%. Part of the reason, however, is that the company stopped importing these products for resale to the private sector in August 1986. Since then, private companies have had to import their own primary petrochemical raw materials directly.

The bad news is that Pemex's primary petrochemical exports also declined sharply. They were down 61.5% to $29 million. The chief culprits were ammonia and ethylene. Exports of each were off 69% last year, yet production of ammonia was down only 14% and ethylene output increased 15%. Pemex officials explain that high domestic demand siphoned supplies away from potential export markets.

Whatever the reasons, Pemex intends to correct the situation. Pemex is building two more ammonia plants, one at Lazaro Cardenas and the other at Camargo. Both plants will have a capacity of 445,000 metric tons per year and will raise Pemex's annual ammonia capacity to 3.8 million metric tons. The two new ammonia plants also fit in nicely with Pemex's plan to take advantage of its huge natural gas reserves.

Construction of the first phase of a major new petrochemical complex at Morelos is expected to be finished by the end of the year and be on stream during the first quarter of 1988. This first phase includes plants to produce ethylene, ethylene oxide and glycol, high-density polyethylene, and acetaldehyde.

Rojas estimates that products from the first-phase plants at Morelos will generate a net trade surplus of $192 million per year. The remainder of the huge Morelos complex is expected to be completed by 1991. Included will be a 350,000-metric-ton-per-year propylene unit to supply feedstock for acrylonitrile, isopropyl alcohol, and polypropylene, all of which will be produced at Morelos.

By 1989, Rojas says, a 100,000-metric-ton butadiene unit also likely will be on stream at Morelos. Mexico needs this plant badly. Pemex now has only one butadiene plant—a 55,000-metric-ton unit at Ciudad Madero—which can't meet domestic demand. Pemex imported 43,600 metric tons of butadiene last year.

Altogether, the many petrochemical projects that Pemex has in the works probably will generate a trade surplus of $1.34 billion per year. That's a lot better, says Rojas, than the $3.3 billion deficit that Pemex would suffer if these projects aren't completed. □

Pemex has ambitious petrochemical plans

Location/product	Capacity (Thousands of metric tons per year)	Status
Camargo		
Ammonia	445	C
Cosoleacaque		
Methanol	825	E[a]
Lazaro Cardenas		
Ammonia	445	E
Ethylene	500	P
Propylene	350	P
Polypropylene	100	P
Propylene oxide	100	P
Methyl *tert*-butyl ether	45	P
Butadiene	60	P
Ethylbenzene	260	P
Styrene	225	P
Linear low-density polyethylene	120	P
High-density polyethylene	120	P
α-Olefins	30	P
Morelos		
Acetaldehyde	150	C
Butadiene	100	E
Ethylene	500	C
Propylene	27	C
Ethane	705	C
Oxygen	350	C
Nitrogen	60	C
Ethylene oxide	100	C
Ethylene glycol	125	C
Acrylic acid	30	E[a]
Acrolein	6	E[a]
High-density polyethylene	100	C
Propylene	350	E
Polypropylene	100	C
Acrylonitrile	50	C
Linear low-density polyethylene	80	P
2-Propanol	75	E
Methyl *tert*-butyl ether	60	P
Pajaritos		
Chlorine	230	P
Vinyl chloride	300	P
Ethylene dichloride (direct)	280	P
Ethylene dichloride (oxy)	215	P
Perchloroethylene	16	P
Carbon tetrachloride	16	P
Perchloroethylene	16	C
Carbon tetrachloride	16	C
Salamanca		
Paraffins, C_{10}-C_{18}	60	P
Olefins, C_{10}-C_{14}	50	P
Salina Cruz		
Benzene	220	P
Toluene	365	P
o-Xylene	60	P
Mixed xylenes	40[b]	P
p-Xylene	240	P
Benzene & mixed xylenes	13[b]	P
Cyclohexane	120	E[a]
Cumene	100	P
San Martin Texmelucan		
Acrylonitrile	50	C
Tula		
Acetonitrile	2	C[a]
Linear paraffins, C_{10}-C_{18}	60	P
Olefins, C_{10}-C_{14}	50	P
Other location		
Acrylonitrile	50	E[a]

Note: C = under construction, E = in engineering, P = in planning. a Temporarily suspended. b 1000 bbl per day.
Source: Petróleos Mexicanos (Pemex)

Demand

During the first half of 1987 demand for chemical professionals was up slightly, but there are some signs it is rising more strongly now

Demand for chemists this year seems to have improved slightly from what it was in 1986. Chemistry department spokesmen characterize the industrial job market for newly graduated chemists as "tough, but not impossible," "okay, but not great," and "seems to be picking up." Many of them add, however, that if the supply of chemists were as large as it was a few years ago, the situation would look much worse.

Chemical engineering departments also report that the job market for B.S. graduates has improved. Many say that at the end of May, 20 to 40% of their 1987 graduates were still looking for work, but that most of them have jobs now. However, some students had to search for a long time before they found work, in contrast to the situation 10 years ago when engineers needed to make little effort to find a position.

In general, the employment market for Ph.D. chemists and chemical engineers is mixed. Candidates from some schools had an easy time finding work, and all found employment by the end of the summer. At other schools, a number of the new Ph.D.s are still looking for work, or else have taken postdoctoral positions only because they failed to locate jobs in industry.

A mixed situation in the job market also is reported by leading chemical companies. Some of them are hiring very few or no new graduates this year as they continue to trim their work forces. Others have expanded their hiring considerably over what it was last year.

According to the College Placement Council, the numbers of job offers received by B.S. and M.S. chemists and chemical engineers were much lower than they were last year, also not a good year, but the offers for Ph.D. chemists and engineers increased slightly. However, these are offers extended before the end of May and do not include the many jobs that were offered during the summer. Also, they do not include teaching positions.

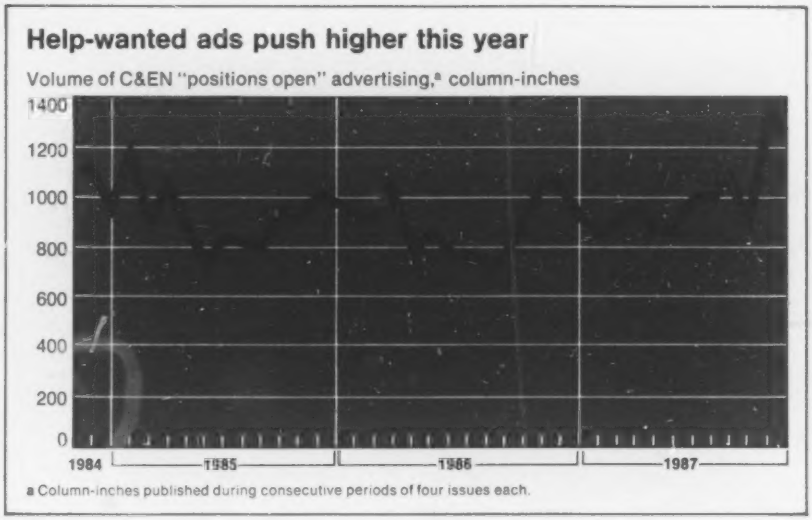
Because profit margins for chemical companies hit 7% for the first half of 1987 (compared with 5% in 1986 and 4% in 1985) and chemical output is up, it would seem that the hiring situation would have improved more than it has. However, a number of factors have kept the number of new positions low at many companies.

Though the volume of early retirement is not nearly so great as it was last year, many companies continue to reduce their work forces with voluntary early retirement programs begun about two years ago. As a result, a greater-than-usual number of older chemists are still competing with new graduates in the job market. At Du Pont, for example, the companywide program encouraging early retirement ended this year, but specific areas of the business still are implementing early retirement.

In general, despite increased profits, companies are continuing to struggle hard to increase productivity and efficiency. One of the major ways they accomplish this is by keeping the number of employees as low as possible. Most firms were extremely careful about the number and qualifications of the employees they hired this year. Nearly all university spokesmen contacted by C&EN remark about the extreme caution with which companies were going about hiring. They say requests for a certain number of candidates from chemistry departments used to come from the company as a whole. Now, individual departments of the firm ask for graduates with very specific qualifications.

Further evidence of this cautious approach is that some firms are making job offers later this year than last. To avoid taking on too many new employees, they are hiring in a shorter time frame, tailoring their offers of new positions very closely to the needs directly at hand.

Another factor that depresses the job market is that oil company profits are still low. Oil companies are better off financially than they were a year ago but are still having difficulties. Therefore, they are hiring a few more chemical engineering graduates than they did last year, though not nearly the number they employ traditionally. Compounding the uncertainty for oil companies is the volatile situation in the Middle



East, which could push oil prices up or down drastically over short time periods.

Other unsettling aspects of the U.S. economy that help keep hiring down in spite of increased profits and chemical output are the five-year-long recession in the agriculture sector, the decline in new housing starts of 10% from a year earlier during the first nine months of 1987, and the decrease in automobile production. Each of these sectors has a large effect on the volume of chemicals consumed in the U.S. and consequently on the expectations of the chemical industry.

Recruiters and placement people have the impression that small and midsize entrepreneurial firms are playing a larger role in employment of new graduates in chemistry and chemical engineering. Most of these firms do not have formal recruiting programs. Many of them call a department head in May or in early summer, asking for the names of a few candidates. This, of course, adds to the number of job offers extended late in the year. "Placement people have begun emphasizing small business," says Rebecca J. Simon, placement director at the school of chemical sciences at the University of Illinois. "Most small companies don't realize they can use the placement offices at colleges and universities to locate candidates."

Reports from chemistry departments at major universities give rather varied pictures of the employment situation. Audrey L. Aylesworth, placement coordinator in the chemistry department at the University of Wisconsin, Madison, reports the job market was "a little bit down" from what it was last year and that "jobs came through really late." Only one third of the B.S. chemistry majors who used the placement service to locate a job in industry were successful. Those who found work averaged only one job offer per person compared with 1.4 in the previous year. Aylesworth says it is taking B.S. students from six months to a year to land something.

Of the Ph.D.s who used the service, 38% found jobs in industry and 44% took postdoctoral positions. About 17% are essentially still looking for work, either continuing with their Ph.D. research or planning to use the placement service in the fall. Offers from companies came through so late this year that several new Ph.D.s grew impatient and took a postdoctoral position when they would have preferred a job in industry. Later, after committing themselves, some received offers from industry.

Aylesworth believes that mergers are continuing to affect the job market. Newly merged companies are shuffling people around instead of hiring new ones, she says.

At the University of Michigan, the job situation seems slightly better. Leah C. Atwater, director of student services in chemistry, reports that the number of recruiters who came to the campus was down about 25% from last year, but B.S. students who were looking for industrial jobs found them. Ph.D. students "had to work hard to find positions but finally got them." She, too, reports that job offers were coming through later than usual. "Companies are being very, very cautious about who they invest in for the future," she notes.

Demand for chemists showed "moderate to low growth from last year to this year" at the University of Illinois, Urbana. Simon attributes this growth to a slowing of merger activity. "Finally, some of these companies have completed mergers and things seem to be fairly calm," she comments.

In contrast, Bert M. Tolbert, associate chairman of the chemistry department at the University of Colorado, reports that the job market for graduates has been good, even though the number of recruiters sent to the campus was down a little from last year. He says that Ph.D.s specializing in analytical and biochemistry are in the most demand and that positions in physical and inorganic chemistry are adequate, especially in the academic field. "None of the Ph.D.s had much trouble finding a job," he says.

A similar upbeat situation was reported by R. Bryan Miller, chairman of the chemistry department at the University of California, Davis. The job market for both B.S. and Ph.D. graduates "looked quite good this year," he says. He notes that most B.S. candidates who wanted to go into an industrial position were able to obtain employment. All the Ph.D. chemists he is aware of secured an industrial, postdoctoral, or teaching position.

The job market for new chemical engineers also has improved. "The general trend seems to be picking up," notes Ronald Darby, professor of chemical engineering at Texas A&M. Though only 50 to 60% of B.S. graduates at Texas A&M had jobs by the end of May, the vast majority have positions now. However, Darby notes that demand for engineers with advanced degrees is still low. "There are jobs out there," he observes, "but students have to go look for them."

He also says that many compa-

nies offered positions much later this year. "Some firms were looking for one or two people in the spring, but this summer called asking for more candidates. We had a lot of calls directly to the department this summer, especially from small firms," he adds. He received inquiries from individual departments of companies asking for specific specialized candidates. Companies seem to be on a shorter time frame in contrast to past years when they decided early in the year how many candidates they would need, he says.

One very encouraging development, Darby observes, is that oil companies offered so many summer jobs for Texas A&M undergraduates this year that not enough students were available to fill them. He believes oil firms are somewhat concerned that the supply of engineers will not be sufficient in the future.

The size of the B.S. graduating class had a great effect on the appearance of the job market at Virginia Polytechnic Institute & State University. William L. Conger, head of the chemical engineering department, says the market has improved from previous years, but only because there are fewer students. The graduating class shrank from 90 in 1985 to 75 in 1986 and 43 in 1987. Though 75 to 80% of the B.S. students had found jobs by the time they graduated, a few still haven't received an offer. He also notes that companies were offering positions later than usual. "Right at the end of May, suddenly jobs were available," he says.

According to industry spokesmen, the job market for chemists and chemical engineers has improved somewhat, but it is still down compared with historical levels. This, however, varies a great deal with individual companies.

Thomas J. Neelen, manager of college relations and recruiting for Union Carbide, says his company recruited about three times more B.S. chemical engineers and Ph.D. chemists and chemical engineers this year than last. In contrast, the modest need for B.S. chemists remained essentially unchanged from last year.

"In 1986, mediocre business conditions and a major reorganization, with both divestments and an early retirement program, made for an extremely cautious hiring environment," Neelan says. With business conditions considerably improved and the major restructuring completed, recruiting activity at Carbide has become relatively strong.

Similarly, more chemists were hired this year than last at Du Pont. In contrast to 1985 and 1986, when Du Pont hiring was unusually low, 64 new chemists were given positions this year. In addition, Du Pont hired more than seven times as many chemical engineers as it did in 1986. Robert K. Armstrong, manager of professional staffing, observes that "the supply and demand of Ph.D. chemists is now in good balance," but, as usual, "B.S. and M.S. chemists absolutely swamped the market."

At Procter & Gamble the number of new Ph.D. chemists hired was down slightly from last year, but remained near the past four-year average, according to Ted J. Logan, manager of Ph.D. recruiting. From talking with recruiters at a recent conference, Logan concludes that for most companies, demand during 1986 and 1987 was essentially average compared with the previous five years. He notes that the size of the research staff at Procter & Gamble is growing faster in life sciences than in chemistry.

Fred O. Schulz Jr., manager of hiring for B.S. chemical engineers at Procter & Gamble and chairman of the supply and demand committee for the American Institute of Chemical Engineering, says that, in general, his impression is that demand for B.S. and M.S. engineers is inching up while supply is crashing. Even so, a significant percentage of engineers still can't get jobs. Procter & Gamble hired essentially the same number of engineers this year as last, he says.

A more gloomy picture of the job market was depicted by Ivory Herbert, manager of staffing at Hoechst Celanese, a company created this year by the acquisition of Celanese by West Germany's Hoechst. Hiring of Ph.D. chemists at Celanese has been reduced for the past few years. Only two new Ph.D. chemists and three B.S.-level chemists were given positions this year. Herbert characterizes the market as "extremely soft. Most companies are restructuring and streamlining and automating manufacturing processes. To remain competitive in national and international markets, they are using a high degree of caution in hiring."

Just as the view of the current job market varies somewhat from university to university and firm to firm, the outlook for next year also seems to vary. Tolbert of the University of Colorado expects the job market will improve further. The University of California's Miller agrees. "I think the brighter picture will continue. The worst of the oil companies' problems are over," he says. Texas A&M's Darby says the

Supply of new chemists and chemical engineers shrinks at undergraduate level but rises for Ph.D.s

Academic year	Degrees awarded in chemistry[a]			Degrees awarded in chemical engineering		
	Bachelors	Masters	Ph.D.s	Bachelors	Masters	Ph.D.s
1974–75	10,649	2006	1824	3142	990	346
1975–76	11,107	1796	1623	3203	1031	308
1976–77	11,322	1775	1571	3581	1086	291
1977–78	11,474	1892	1525	4615	1237	259
1978–79	11,643	1765	1518	5655	1149	304
1979–80	11,446	1733	1551	6383	1271	284
1980–81	11,347	1654	1622	6527	1267	300
1981–82	11,062	1751	1722	6740	1285	311
1982–83	10,746	1604	1746	7145	1304	319
1983–84	10,704	1667	1774	7475	1514	330
1984–85	10,196	1598	1631	7146	1544	418
1985–86	9,893	1592	1737	5877	1361	446

a Data do not include biochemistry and geochemistry. **Source:** Department of Education's National Center for Education Statistics

Demand for chemistry faculty at universities rises

Though industrial demand for chemists and chemical engineers is steady or perhaps up slightly, demand for chemistry faculty at universities and colleges seems to have risen substantially over the past few years.

Concrete figures are not available on how demand has changed. However, a survey of current openings was done this year by an ad hoc committee appointed by Edward F. Hayes, former head of the chemistry division at the National Science Foundation. The committee was cochaired by Clayton H. Heathcock and Robert G. Bergman, professors at the University of California, Berkeley.

"There is a widespread belief among department heads that it is getting harder and harder to fill vacancies on chemistry faculties," Heathcock says. "NSF is concerned that inadequate funding of chemistry faculty is causing people to turn away from the profession."

For the survey, a questionnaire was sent to 188 chemistry departments; 156, with a total of 3581 full-time equivalent positions, responded. The results show that during the past year there were 316 chronic vacancies—positions that have been unfilled for a year or more. The average duration of the chronic vacancy was two and a half years.

The fields in which most vacancies appeared are organic (78), physical (57), analytical (52), inorganic (48), and biochemistry (27).

A National Research Council report on doctorate recipients from U.S. universities says that of the 1631 Ph.D.s who graduated in 1985, only 147 expressed an interest in teaching. Even if the number was somewhat higher in 1987, it likely would not have been high enough to fill the demand.

Many chemistry department heads believe that students are turning away from teaching because they believe that research funding is very difficult to secure in academia. Students also think industrial positions pay better, are more secure, and involve less pressure.

impression he has received from recruiters is that "things are now picking up significantly," and expects next year will be better than 1987.

Logan of Procter & Gamble predicts that hiring of Ph.D. chemists in 1988 will be up slightly from 1987. Armstrong of Du Pont says that "with a solid economy predicted through 1987 and on into 1988, we believe the job market will be good for chemists."

A number of observers expect the hiring situation in 1988 will be almost the same as it was this year. Whatever they see as the current job market seems to carry over into their views of next year. Herbert of Hoechst Celanese, for example, who believes the job market was poor this year, thinks it will continue to be soft in 1988.

Atwater of the University of Michigan shares this view. She sees the current market as difficult and believes the situation will stay the same. Virginia Tech's Conger also predicts no major change next year. In short, though assessments of the current situation vary, most observers see little change next year.

In its latest employment report, the College Placement Council says that bachelors degree candidates in chemistry received 76% fewer offers, as of June 5, 1987, than they received by the same date in 1986. Likewise, B.S. chemical engineers experienced a 24% decline in the number of offers. However, these figures may represent underreporting by the universities and the later-than-usual dates at which companies were offering jobs rather than a real decline in the volume of offers. Also, they may reflect that small and midsized companies are now playing a larger role in hiring. For doctoral candidates, offers were up 8% for chemists and 28% for chemical engineers.

In contrast to the fall in job offers reported by the College Placement Council, the overall unemployment rate for ACS-member chemists fell from 1.7% in March 1986 to 1.1% in March 1987, a statistic that has not been so low since 1981. The unemployment rate was 1.7% for B.S. chemists, 1.3% for M.S. chemists, and 0.8% for Ph.D. chemists, compared with 2.6% for B.S.s, 1.7% for M.S.s, and 1.3% for Ph.D.s in 1986. In March, the general unemployment rate was about 6%.

According to the ACS Office of Statistical Services, the unemployment rate for newly graduated B.S. chemists of about 13% was essentially unchanged from last year. For B.S. chemical engineers who graduated in 1987, it has dropped to 18% from 21% in 1986.

AIChE reports that the overall unemployment rate among its members rose from 2.8% in February 1985 and 3.2% in February 1986 to 3.7% in March 1987. However, Trudy Hutter, manager of member employment and professional development services, says the unemployment figure now is down to between 2 and 3%. "My general impression from talking with recruiters and companies all over the country is that the job market is improving tremendously, though I don't have concrete figures," she says.

Audra B. Rafter, manager of the ACS's Employment Aids Office, which operates the ACS National Employment Clearing House, says that the latest clearinghouse at the ACS national meeting in New Orleans in September was the best overall—particularly with respect to employers and employer activity—since the clearinghouses in New York City in 1981 and in Philadelphia in 1984. The ratio of candidates to employers was better than at any meeting since 1980. There were 455 positions posted and 544 candidates.

Recruiters showed the greatest interest in analytical chemists (107 positions listed), organic chemists (82), biochemists (51), postdoctoral chemists (36), polymer chemists (34), chemical engineers (34), physical chemists (22), and teachers (20).

The volume of position-open advertising in C&EN also shows a sudden upturn in demand for chemical professionals. For September, the volume of advertising was higher than it was in any month in the past three years. The number of column inches in the first 40 issues of 1987 was 9708, 15% higher than in the first 40 issues of 1986. □